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## TECHNICAL NOTE

# The free thoracodorsal artery perforator flap in head and neck reconstruction

C.-A. Bach<sup>a,b,\*</sup>, I. Wagner<sup>a</sup>, X. Lachiver<sup>a</sup>, A. Guth<sup>c</sup>, A.-C. Baglin<sup>d</sup>,  
F. Chabolle<sup>a,b</sup>

<sup>a</sup> Service de chirurgie ORL et cervico-faciale, hôpital Foch, 40, rue Worth, 92150 Suresnes, France

<sup>b</sup> Université de Versailles Saint-Quentin en Yvelines, UFR de médecine Paris-Ouest Saint-Quentin en Yvelines, 3, rue de la division Leclerc, 78280 Guyancourt, France

<sup>c</sup> Service de radiologie, hôpital Foch, 40, rue Worth, 92150 Suresnes, France

<sup>d</sup> Service d'anatomo-pathologie, hôpital Foch, 40, rue Worth, 92150 Suresnes, France

## Introduction

Free flaps have transformed head and neck reconstructive surgery after cancer resection by allowing increasingly optimal anatomical and functional restorations.

The plastic qualities of the fasciocutaneous radial forearm flap make it the first-line choice for reconstruction of the oropharyngeal region. However, the donor site is very visible, resulting in considerable morbidity.

Perforator flaps have been developed to decrease donor site morbidity. These flaps harvest skin and subcutaneous tissue pedicled on a perforator artery rather than on a central pedicle. Only the required volume of tissue is harvested, thereby preserving a maximum of healthy structures at the donor site.

The thoracodorsal artery perforator flap (TAP), first described in 1995 by Angrigiani et al. [1] which has an increasing number of clinical applications in reconstructive surgery (breast, thorax, limbs) is also suitable for the repair of head and neck defects.

We describe the harvesting technique and the main characteristics of this flap.

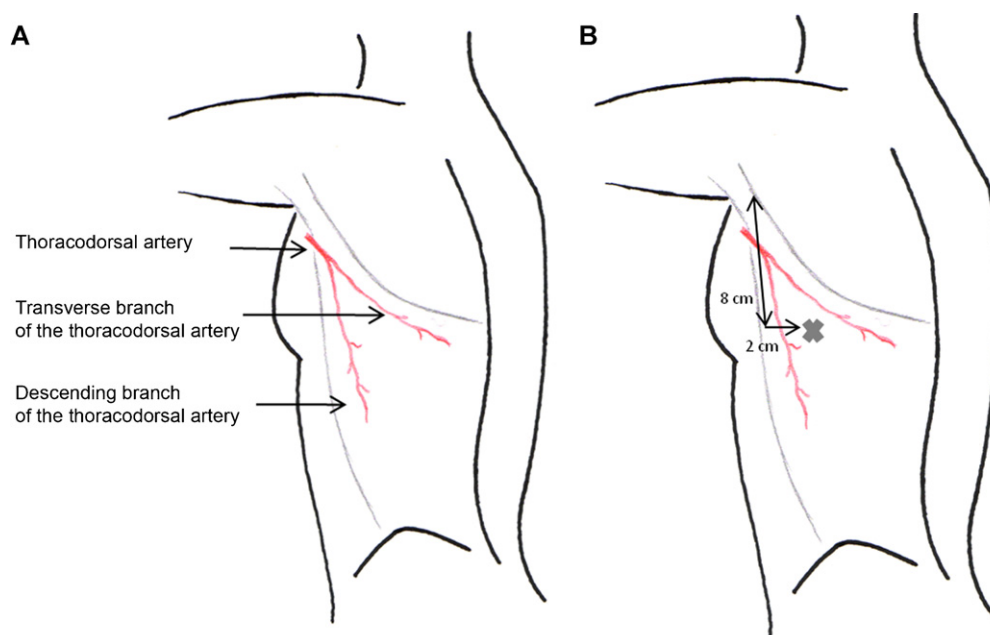
## Anatomical basis of the thoracodorsal artery perforator flap

After arising from the subscapular artery, the thoracodorsal artery descends medially over a mean distance of 2.5 cm on the deep surface of the *latissimus dorsi* muscle and then divides into two muscle branches: a horizontal branch (transverse or medial) and a vertical branch (descending or lateral) (Fig. 1A). The horizontal branch travels parallel to the muscle about 3.5 cm from its superior border. The lateral branch travels vertically about 2.5 cm medial to the lateral border of the muscle [2]. These two branches then become intramuscular. One or several perforator branches supplying the skin arise from these intramuscular branches. These musculocutaneous perforator branches constitute the blood supply of the TAP flap.

A single perforator is sufficient to ensure the blood supply of a skin paddle of up to 15 × 25 cm [1]. Perforators derived from the descending branch have a shorter intramuscular course and are preferred to perforators derived

\* Corresponding author. Tel.: +33 1 46 25 22 31.

E-mail address: [christine.bach@hopital-foch.org](mailto:christine.bach@hopital-foch.org) (C.-A. Bach).



**Figure 1** A. Anatomy of the thoracodorsal artery. B. Anatomical landmark of the musculocutaneous perforator derived from the descending branch of the thoracodorsal artery according to Angrigiani [1].

from the horizontal branch. Anatomical studies have demonstrated an average of more than three musculocutaneous perforators larger than 0.5 mm in diameter, predominantly arising from the descending branch [2–4]. Direct cutaneous perforator branches may also arise from the thoracodorsal artery before it enters the *latissimus dorsi* muscle [2].

Two anatomical landmarks based on fresh cadavre dissections have been described in order to facilitate harvesting of the flap. The first landmark, described by Angrigiani et al. [1] is used to locate the main perforators derived from the descending branch as it leaves the muscle in the subcutaneous tissue. It is situated 8 cm inferior to the posterior axillary line and 2 cm medial to the lateral border of *latissimus dorsi* (Fig. 1B). The second landmark is the point of bifurcation of the thoracodorsal artery into descending and transverse branches. Heitmann et al. [2] considered that all perforators were distributed around this point. This landmark is situated 4 cm inferior to the tip of the scapula and 2.5 cm medial to the free border of *latissimus dorsi*. The position of the patient (sitting, supine) and the patient's arm can modify localization of the perforators based on the described anatomical landmarks. Preoperative Doppler ultrasound is recommended to visualize the perforators and underlying anatomical structures.

## Operative technique

Doppler ultrasound is performed on the day before or on the day of the operation to precisely locate the perforator around which the skin paddle will be raised. It is performed with the patient in the supine position and the arm in 90° of abduction in order to locate the perforators under the same

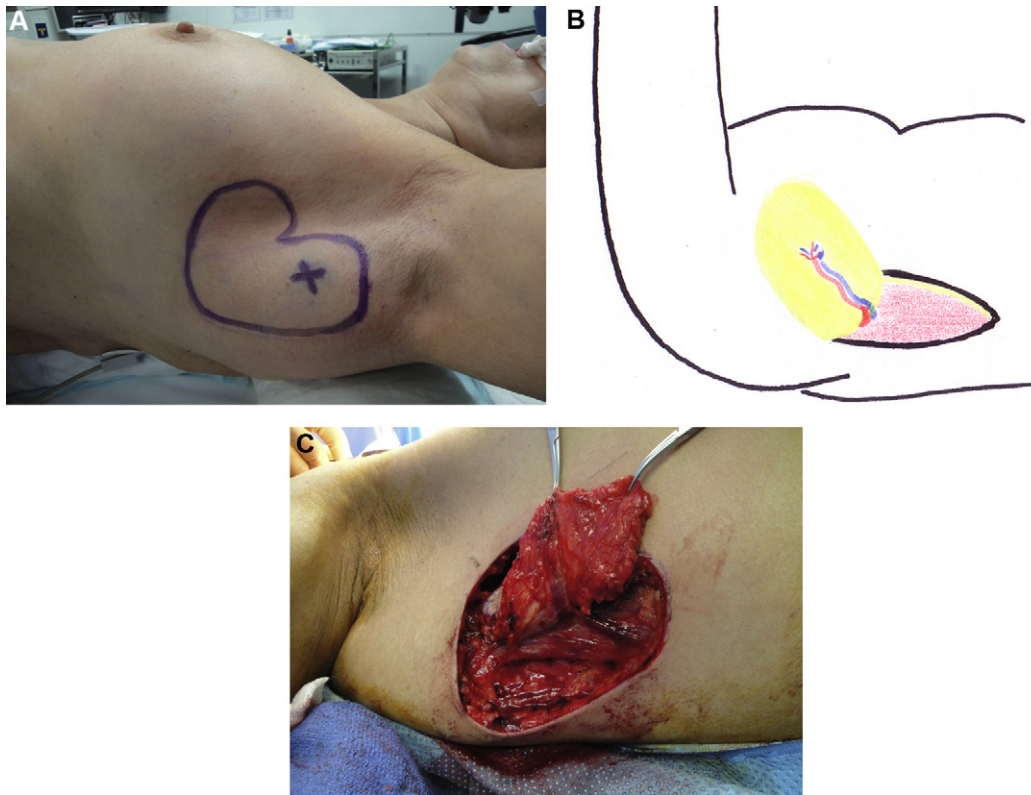
conditions as during the operation. The perforator identified with a diameter greater than 0.5 mm is the closest perforator to the anterior border of *latissimus dorsi* and is derived from the thoracodorsal artery. The suprafascial course of the perforator is also evaluated when a defatting refinement of the skin paddle is planned [5].

During the operation, the patient is installed in the supine position with a block underneath the shoulders and the arm, in 90° of abduction, is left free in the surgical field. This installation allows the two teams, that ensuring resection of the head and neck lesion, and that harvesting the flap, to work at the same time.

The skin paddle, usually vertical, includes the perforator identified (Fig. 2A). Design of the flap takes into account skin laxity and the possibilities of closure on completion of the resection. In the absence of preoperative ultrasound, the landmarks described by Angrigiani et al. can be used.

The skin incision, penetrating as far as the fascia, starts at the anteroinferior border of the flap, allowing identification of the anterior border of *latissimus dorsi* and repositioning of the anterior limit of the skin paddle if necessary, for example in the case of a direct cutaneous perforator (Fig. 2B). After identifying the perforator, the distal limit of the skin paddle is incised. Only pulsatile perforators larger than 0.5 mm in diameter are considered to be reliable and are preserved. Dissection can be performed with magnifying glasses.

There is a high risk of rupture or avulsion of the perforator when the perforator is less than 0.5 mm in diameter and when it is non-pulsatile or only weakly pulsatile. In this case, the perforator flap should then be converted into a muscle-sparing *latissimus dorsi* flap. Harvesting of the flap comprises a 2 to 5 cm strip of muscle around the main perforator, depending on its quality. A large muscle flap ensures the inclusion of a maximum number of perforators in order to



**Figure 2** A. The skin paddle is designed by including the perforator identified by Doppler ultrasound. B. Dissection is performed from distal to proximal in order to identify the musculocutaneous perforator. C. Intramuscular dissection of the perforator is continued as far as the descending branch of the thoracodorsal artery.

increase flap reliability [6]. Nerve branches ensuring innervation of this segment are then sacrificed.

Once the skin paddle has been completely incised, dissection of the musculocutaneous perforator is continued from distal to proximal. A plane of cleavage is created through the *latissimus dorsi* muscle by dissection in the direction of muscle fibres in order to preserve their integrity and to release the perforator as far as the medial surface of the muscle and the arterial branch from which the perforator is derived (descending or transverse branch) (Fig. 2C). Dissection is performed flush with the pedicle in order to ligate muscle branches by means of surgical clips or bipolar cautery. Nerve branches are released atraumatically and preserved. A window is created within the muscle, allowing subsequent passage of the skin paddle (Figs 3A and B).

Dissection of the thoracodorsal artery is then continued in the inferosuperior direction until the desired length is obtained.

The skin paddle is introduced through the window created in the *latissimus dorsi* muscle. The flap is then weaned (Fig. 3C). Skin closure is performed over a drain (Fig. 4).

## Discussion

The thoracodorsal artery perforator flap is not widely used in head and neck surgery. It possesses all of the characteristics of the ideal flap described by Lyons [7] for soft tissue reconstruction of the head and neck.

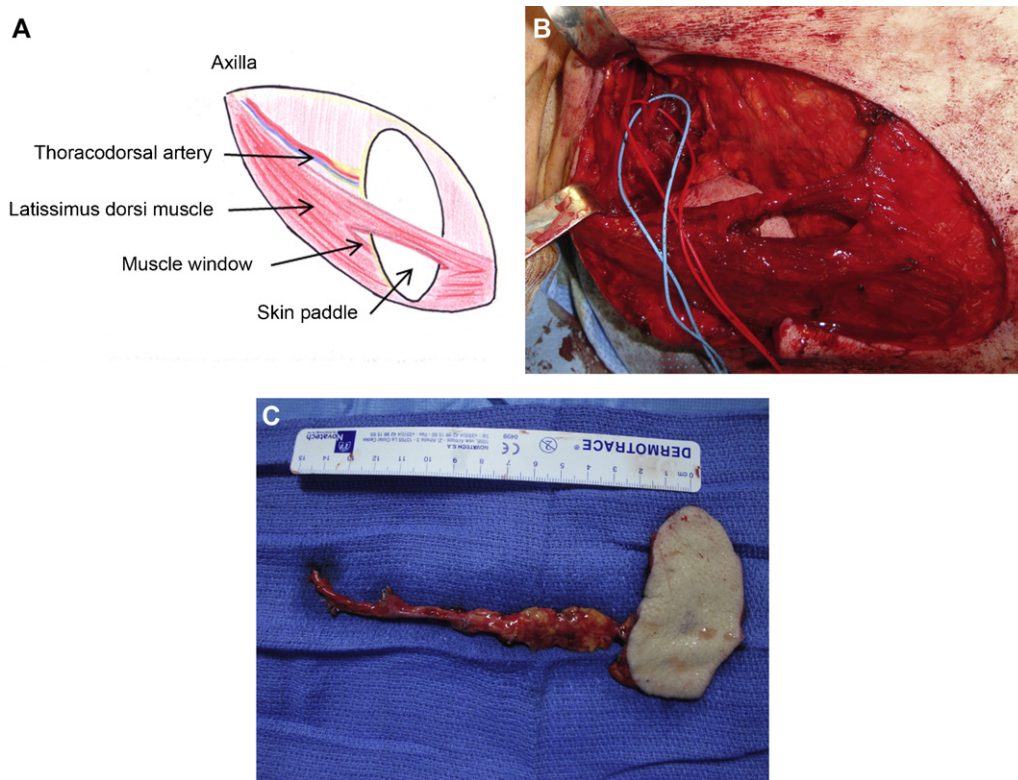
The two surgical teams are able to work simultaneously, as flap harvesting can be performed with the patient in a supine position.

The size of the skin paddle can be sufficient to cover large areas of skin or mucosa, which can be a major advantage in extensive cancer resections. By evaluating the type of perforators [5], preoperative Doppler ultrasound allows the suprafascial thickness of the flap to be decreased either macroscopically or by magnifying glasses in order to obtain a very thin and uniform paddle that can be easily positioned in the head and neck. The hairless nature of the skin paddle allows it to be used for intraoral reconstructions. In our experience, these properties have allowed us to perform oropharyngeal reconstructions with anatomical restoration equivalent to that obtained with a forearm flap.

The length of the pedicle, an average of 15 cm [3,8], is comparable to that of the radial forearm flap. A long pedicle constitutes an advantage, particularly in cancer surgery, in which the number of available recipient neck vessels is often very limited. Anastomosis can be performed with any neck vessel without the need for a vein graft, which increases the operating time and the risk of thrombosis.

The size of the vessels is satisfactory, as microanastomoses are created with the thoracodorsal arteries with a diameter of about 2 mm. All free composite flaps of the axillary region based on the thoracodorsal artery can be associated with the thoracodorsal artery perforator flap paddle for complex head and neck reconstructions.

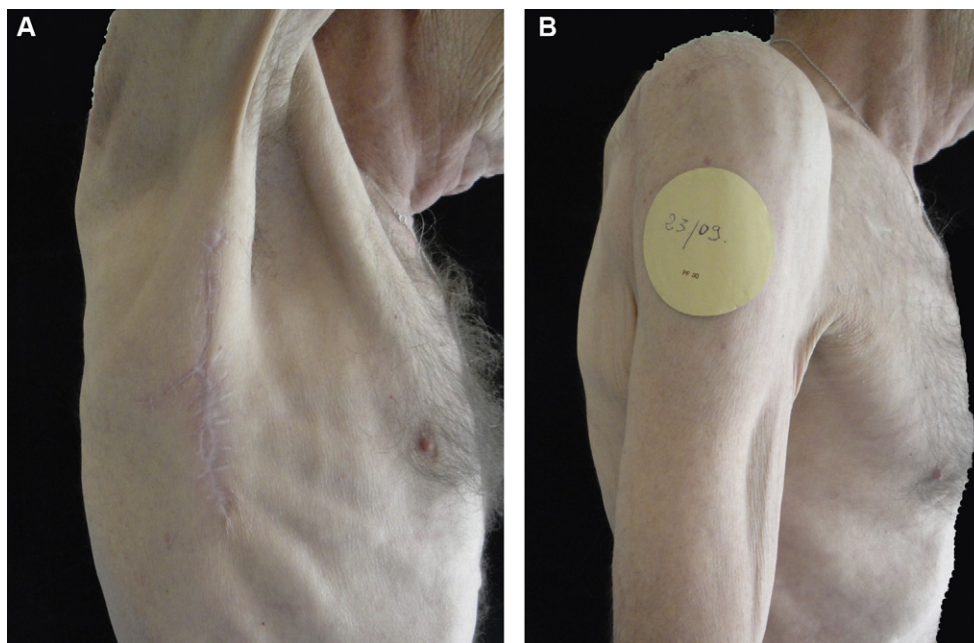




**Figure 3** A. Diagram of passage of the skin paddle through the muscle window. B. All of *latissimus dorsi* is preserved. The flap can be weaned after introducing the skin paddle through the muscle. C. The pedicle of the flap is sufficiently long to be anastomosed to neck vessels without the need for a vein graft.

The thoracodorsal artery perforator flap is a reliable flap. In a series of 100 thoracodorsal artery perforator flaps in 99 patients reported by Hamdi et al. [6], only one case of complete flap necrosis was reported (1%).

In the presence of anatomical variants not detected by preoperative Doppler ultrasound or in the case of damage to the perforator, the skin paddle can be repositioned during the operation following demonstration of another



**Figure 4** A. The donor site is self-closing. Appearance of the scar six months postoperatively. B. The scar is hidden in the axilla. Appearance six months postoperatively.

perforator. If the diameter of the perforator is considered to be insufficient, the perforator flap can be converted into a muscle-sparing *latissimus dorsi* flap. This flap can therefore be harvested regardless of the local anatomical conditions.

Harvesting of the thoracodorsal artery perforator flap is more difficult than that of the forearm flap. The flap must be handled very carefully to avoid avulsion of the perforator as it enters the skin paddle. Intramuscular dissection must be meticulous to avoid damage to the veins associated with the perforator and vasospasm of the pedicle [9].

Donor site morbidity is minimal. The shape of the back is preserved, as the thickness of the *latissimus dorsi* muscle is not modified by flap harvesting. Sparing of the motor nerve of *latissimus dorsi* preserves muscle strength after surgery and a full range of shoulder movements [6]. The absence of dead space in the axilla and preservation of *latissimus dorsi* function are associated with a decreased incidence of seroma, a frequent complication of *latissimus dorsi* muscle flap harvesting [6]. The skin paddle is self-closing in every case, leaving a hidden axillary scar.

## Conclusion

As surgery for head and neck cancer now systematically comprises reconstruction, the functional and cosmetic sequelae of the flap donor site must be decreased. The thoracodorsal artery perforator flap, with a skin paddle presenting the same advantages as those of the radial forearm flap, can be used to perform the same type of head and neck reconstruction with considerably decreased donor site morbidity and a hidden scar.

## Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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